The Entity Relationship Model 1

- A simple ER model
  - The Village Cinema database
- Concepts in ER modelling
  - Entitey set / Relationship set
  - Constraints
- Mapping E/R diagrams into relational database schemas

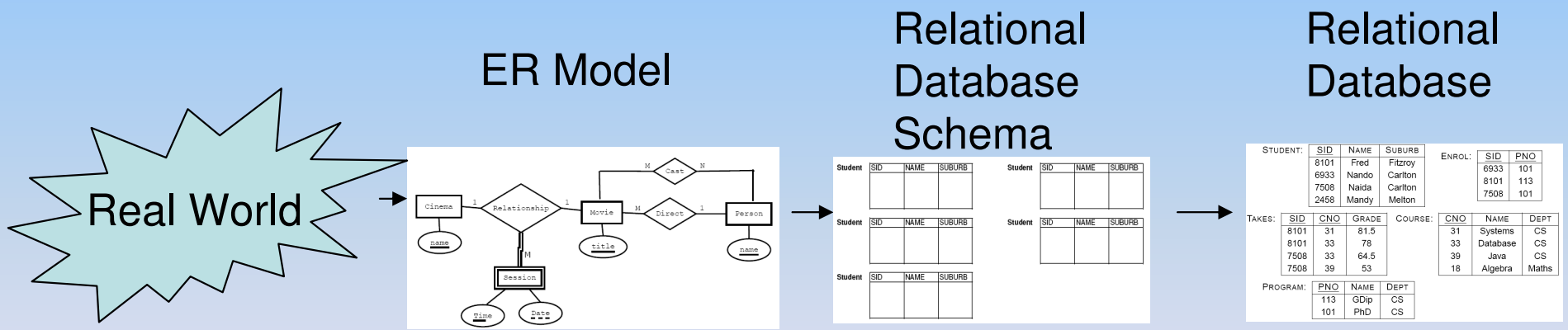
Readings: Sections 4.1.1—4.1.10, 4.3, and 4.5.1– 4.5.2 of Textbook.

Purpose of E/R Model

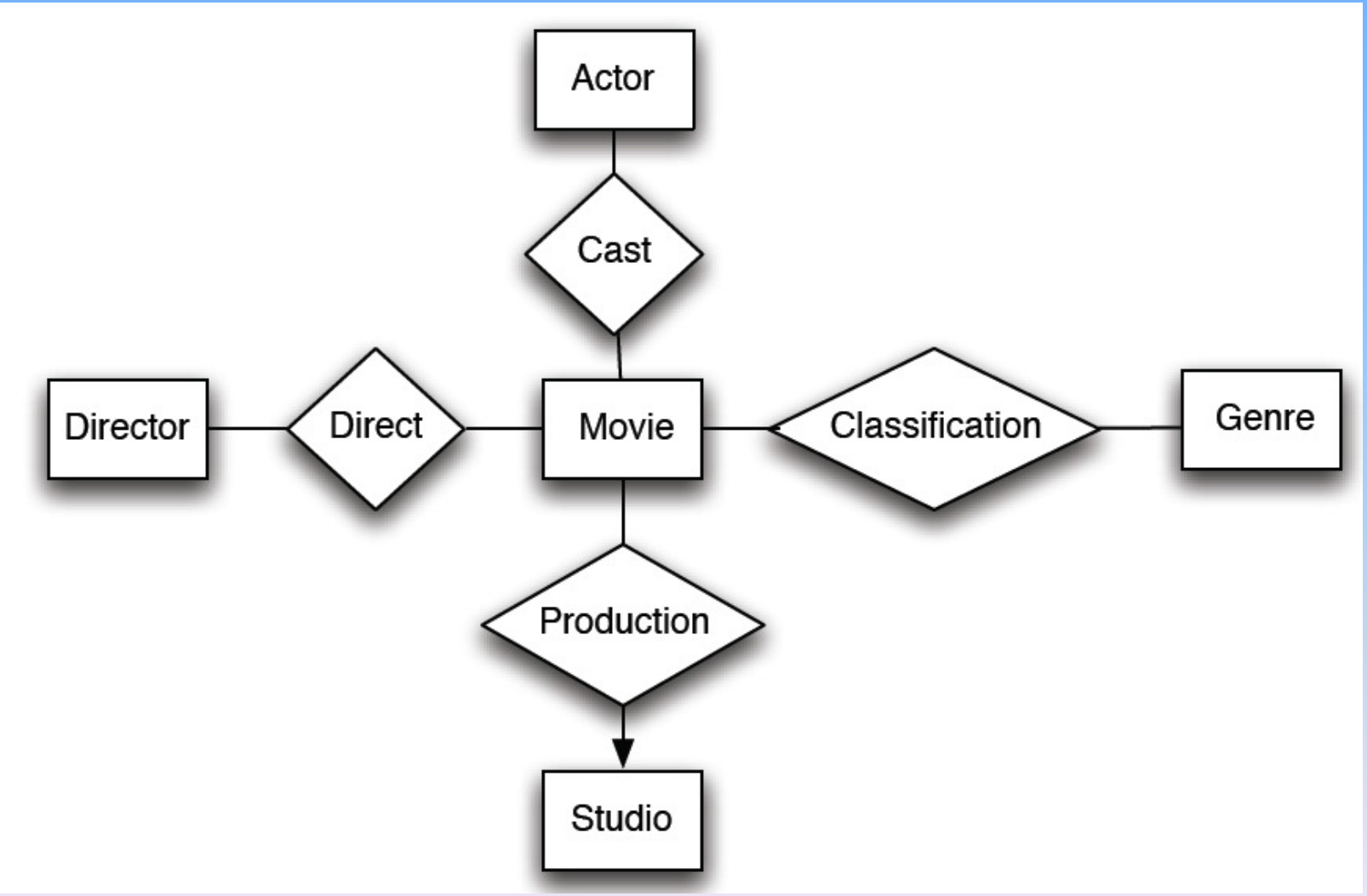
- The E/R model allows us to sketch database schema designs.
  - Includes some constraints, but not operations.
- Designs are pictures called entity-relationship diagrams.

Purpose of E/R Model ...

- Design a relational database schema from an ER model.
  - ER Diagram → Relational Database Schema



A sketchy E/R model for the Village Cinema database



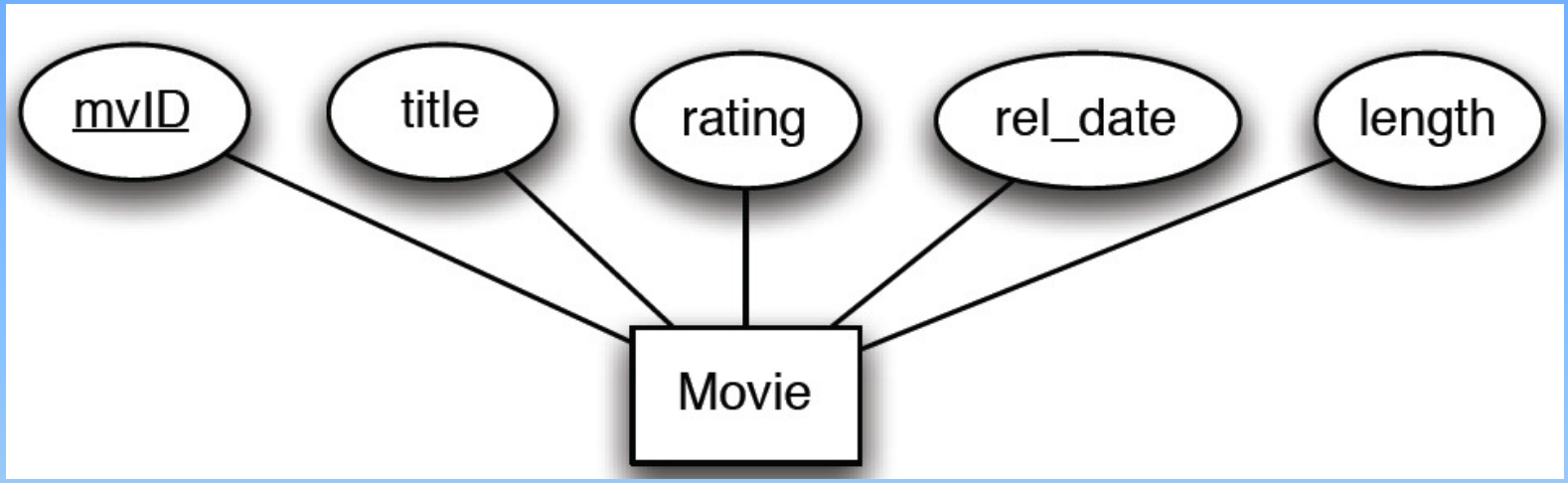
Entity Sets

- Entity = “thing” or object.
- Entity set = collection of similar entities.
  - Similar to a class in object-oriented languages.
- Attribute = property of (the entities of) an entity set.
  - Attributes are simple values, e.g. integers or character strings, not structs, sets, etc.

E/R Diagrams

- In an entity-relationship diagram:
  - Entity set = rectangle.
  - Attribute = oval, with a line to the rectangle representing its entity set.

Entity Set and Entity



Entity set Movie has the following information, called attributes, to be kept in the database:

- mvID, title, Rating, release-date, length,

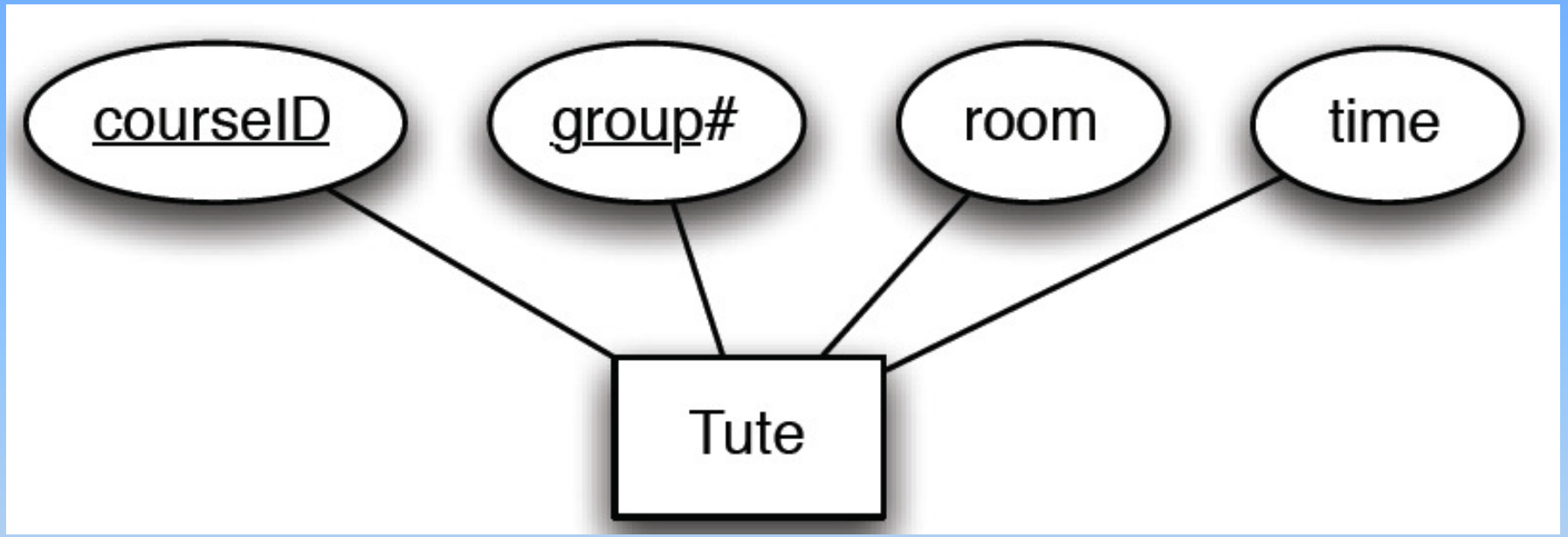
Each Movie entity has values (or data) for these attributes. For example,

- Movie 1: (1, 'Angels & Demons', 'M', 14-05-2009, 138)
- Movie 2: (2, 'Coco Avant Chanel', 'PG', 25-06-2009, 108)

Keys

- A key is a set of attributes for one entity set such that no two entities in this set agree on all the attributes of the key.
  - It is allowed for two entities to agree on some, but not all, of the key attributes.
- We must designate a key for every entity set.
- Underline the key attribute(s).
  - If there are more than one possible keys, choose one as the primary key and underline its attributes.
  - All attributes in the primary key must be underlined.

Example: A multi-attribute Key

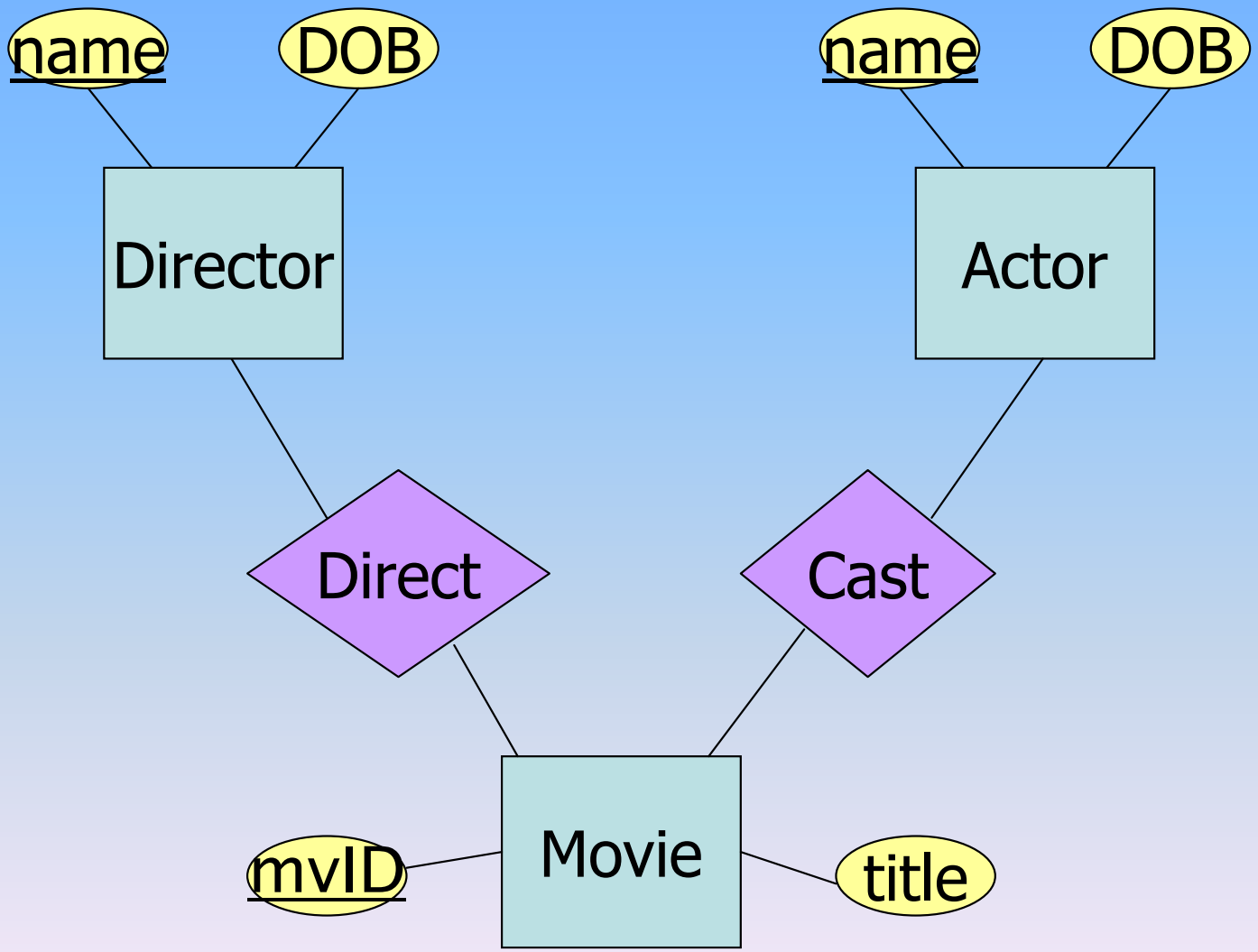


- Note that room and time together can also be a key, but we must select only one key.

Relationships

- A relationship connects two or more entity sets.
  - A binary relationship connects two entity sets.
- It is represented by a diamond, with lines to each of the entity sets involved.

Example: Relationships



Directors direct movies.

Actors cast in Movies.

Relationship Set

- The current “value” of an entity set is the set of entities that belong to it.
  - Example: the set of all movies in our database.
- The “value” of a relationship is a relationship set, a set of tuples with one component for each related entity set.

Example: Relationship Set

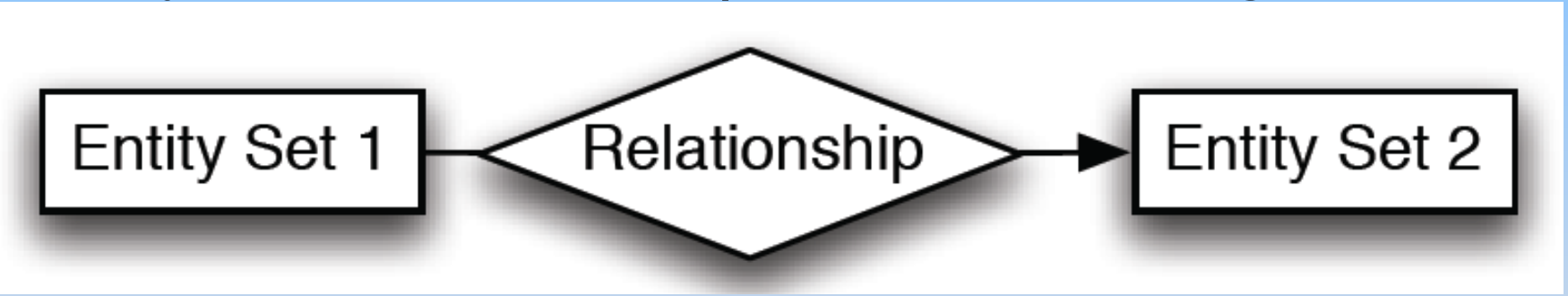
- For the relationship Cast, we might have a relationship set as follows. Note that Actor name and MvID are used to represent the Actor and Movie entities.

Actor	Movie
Tom Hanks	1 (Angels & Demon)
Audrey Tautou	2 (Coco Avant Chanel)
Benolt Poelvoorde	2 (Coco Avant Chanel)
Alessandro Nivola	2 (Coco Avant Chanel)
Marie Gillain	2 (Coco Avant Chanel)
Daniel Radcliffe	3 (Harry Potter)
Emma Watson	3 (Harry Potter)
Ruper Grint	3 (Harry Potter)

Be Precise: The Multiplicity of Relationships

- One-One relationship: arrow entering both sides.

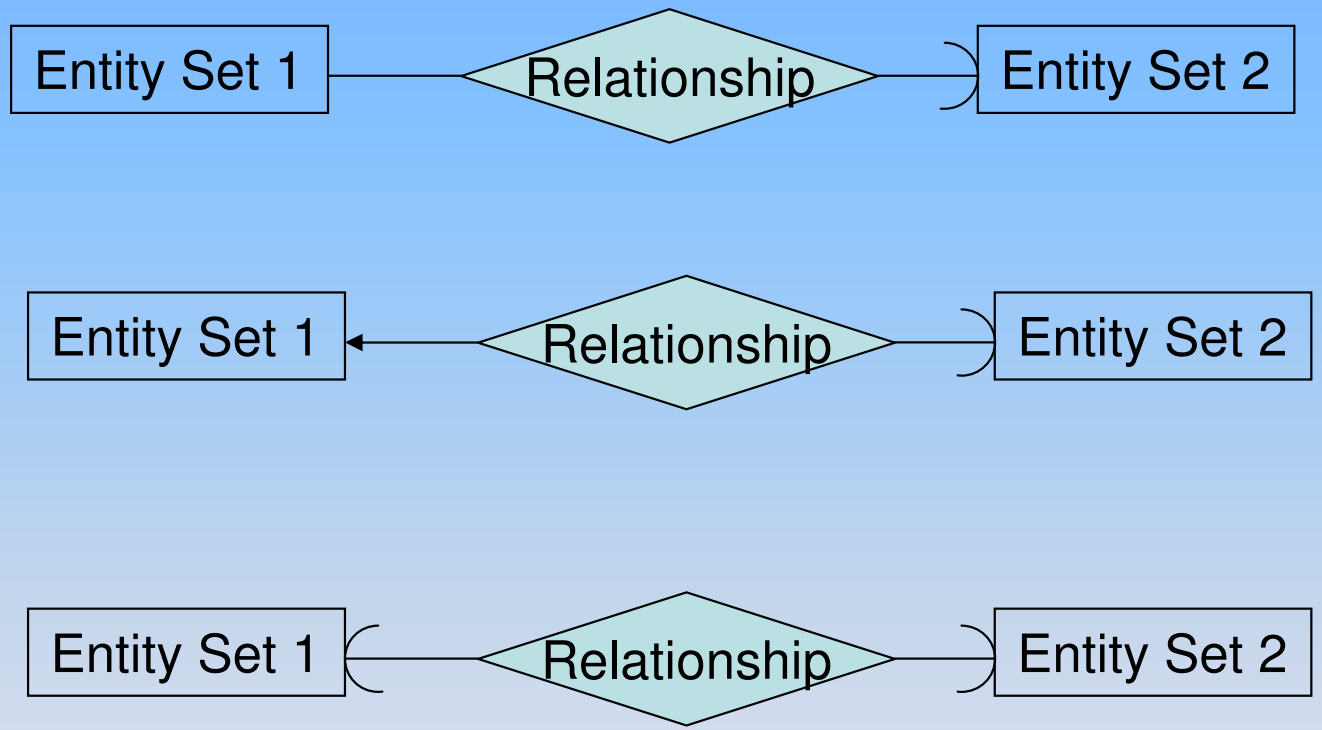
- Many-One relationship: arrow entering “one” side.



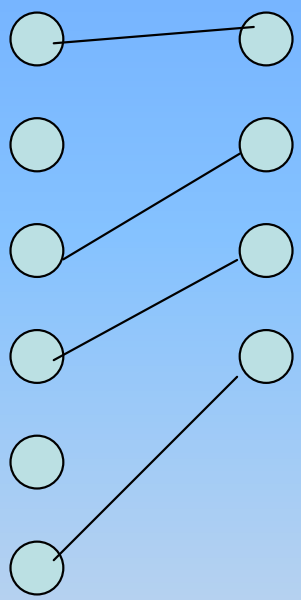
- Many-Many relationship: no arrows.

Be Precise: The Multiplicity of Relationships

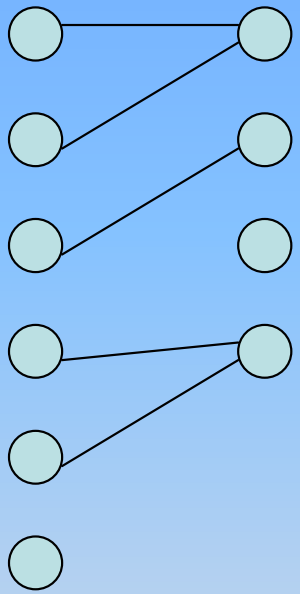
- Exactly one: round arrow.



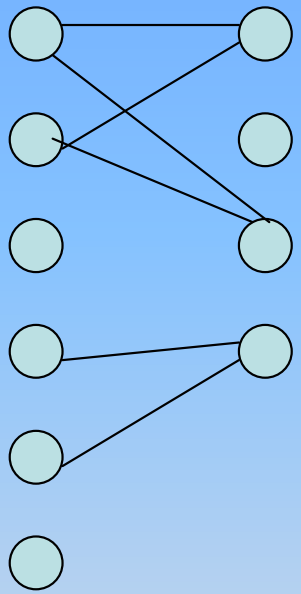
Be Precise: the Multiplicity of Relationships



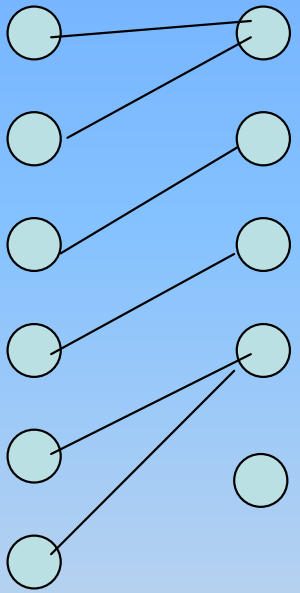
one-one



many-one



many-many



many-exactly one

One-One Relationships

In a one-one relationship, an entity of either entity set is related to at most one or exactly one entity of the other set.

Example: A movie must be produced by exactly one studio, and studio can have at most one best movie of its own (a studio that does not produce any movies may exist).

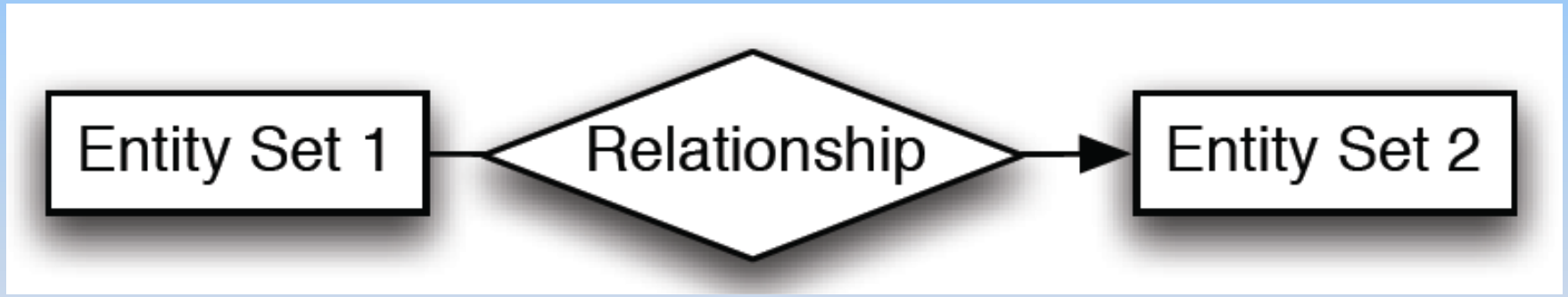
One-One Relationships ...

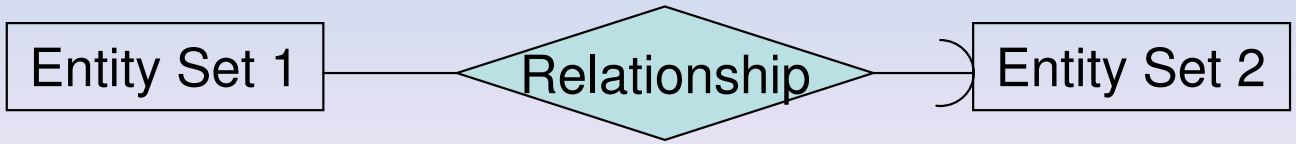
Movie	Studio
The Shawshank Redemption	Castle Rock Entertainment
The Godfather	Alfran Productions
The Godfather: Part II	Paramount Pictures
Il buono, il brutto, il cattivo	Arturo González Producciones Cinematográficas
Pulp Fiction	A Band Apart
Schhindler's List	Universal Pictures
The Dark Knight	Warner Bros Pictures
12 Angry Men	Orion-Nova Productions
One Flew Over the Cuckoo's Nest	Fantasy Films

Source: Top 250 movies from The internet movie database (http://www.imdb.com/title/tt0073486/).

Many-One Relationships

- Each entity of the first set is connected to at most (or exactly) one entity of the second set.
- But an entity of the second set can be connected to zero, one, or many entities of the first set.

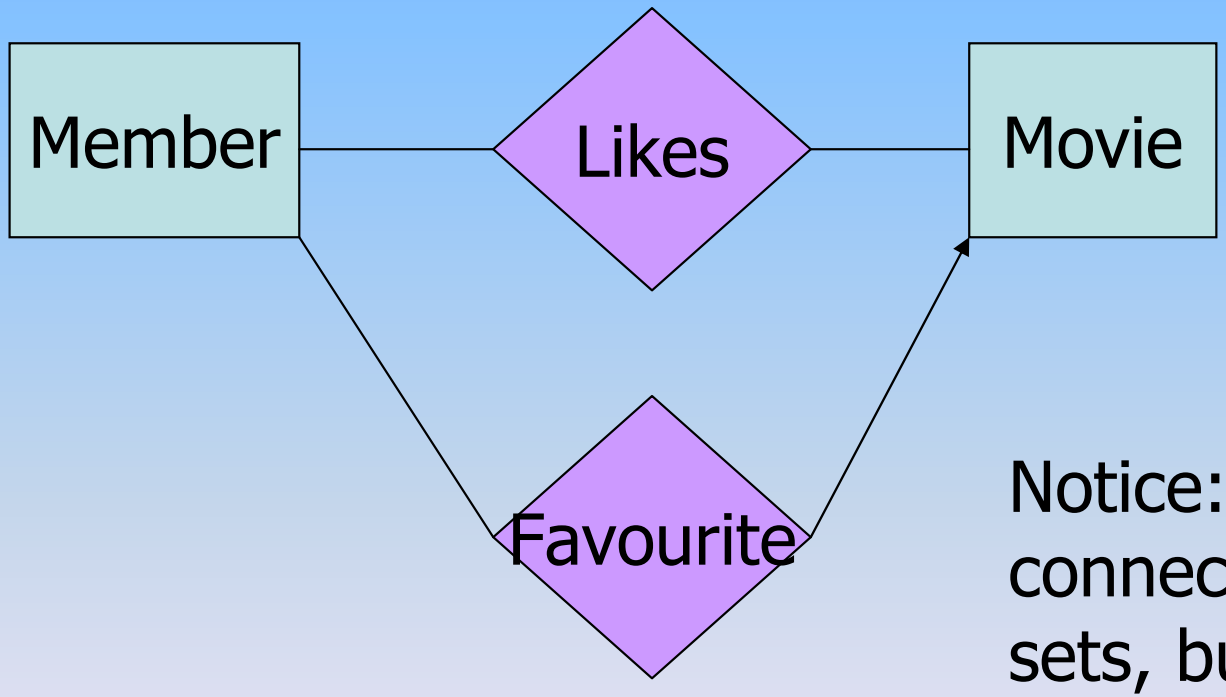




Example: Many-One Relationship

- Member-*Favourite*-Movie: many-one.
  - A member has at most one favorite movie.
  - A movie can be the favorite of any number of members, including zero.

Example: Many-One Relationship ...



Notice: two relationships connect the same entity sets, but are different.

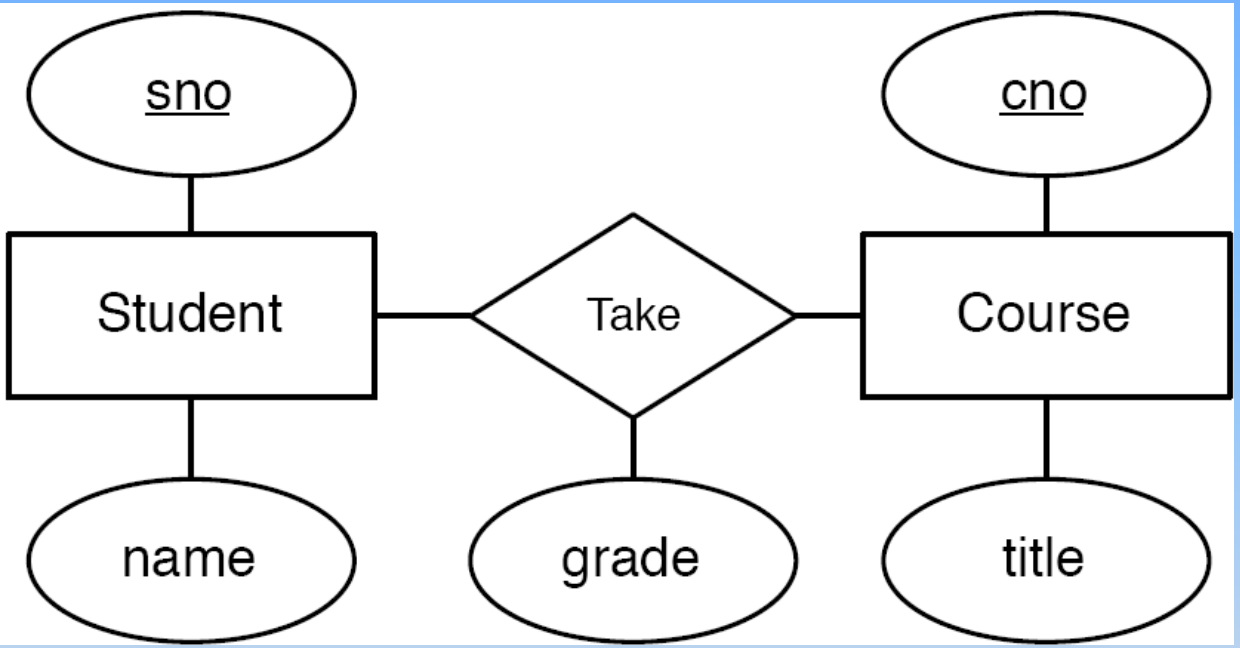
Many-Many Relationships

- An entity of either set can be connected to many entities of the other set.
- Example: An actor performs in many movies; a movie has many actors.

Attributes on Relationships

- Sometimes it is useful to attach an attribute to a relationship.
- Think of this attribute as a property of tuples in the relationship set.

Example: Attributes on Relationships

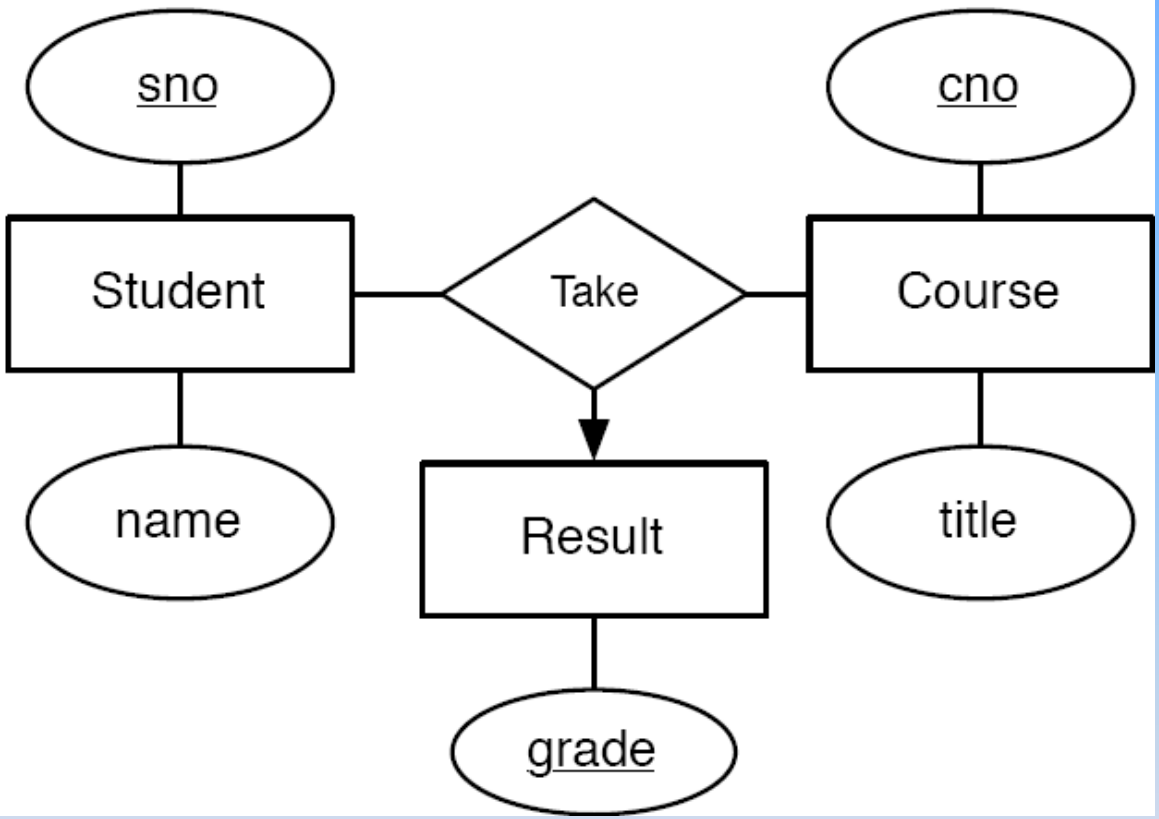


Grade is a function of both Student and Course.

Equivalent Diagrams Without Attributes on Relationships

- Create an entity set representing values of the attribute.
- Make that entity set participate in the relationship.

Example: Removing Attributes from Relationships

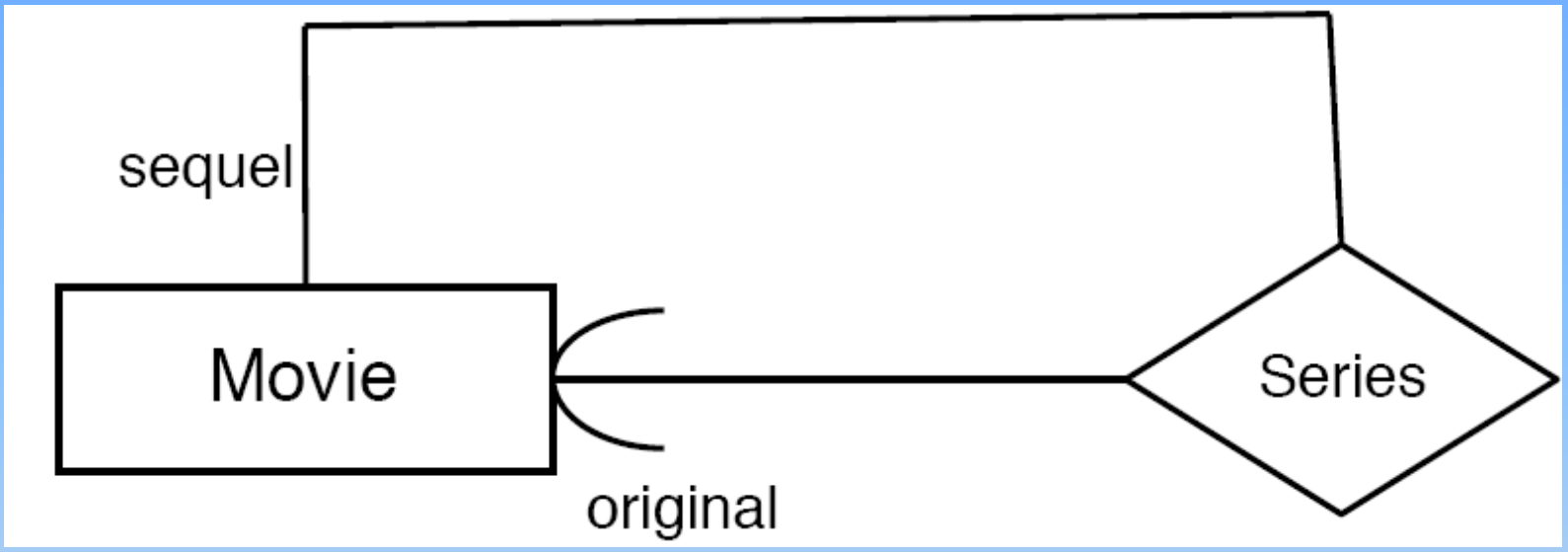


Note convention: arrow from multiway relationship = "all other entity sets together determine a unique one of these."

Roles

- Sometimes an entity set appears more than once in a relationship.
- Label the edges between the relationship and the entity set with names called roles.

Example: Roles



Original	Sequel
Romancing the Stone	The Jewel of the Nile
Batman Begins	The Dark Knight
Lethal Weapon	Lethal Weapon 2
Spider Man	Spider Man 2
Spider Man	Spider Man 3
Toy Story	Toy Story 2
Ice Age	Ice Age 2
Ice Age	Ice Age 3

From E/R Diagrams to Relations

- Entity set → relation.
  - Attributes → attributes.
  - Entity set key → relation key
- Relationships → relations whose attributes are only:
  - The keys of the connected entity sets.
  - Attributes of the relationship itself.

Mapping relationships: keys and foreign keys in the mapped relation

ER relationships to relations: Keys of related entity sets form the primary key and foreign keys of the resultant relation.

- All keys of related entity sets become foreign keys of the resultant relation.
- Some or all keys of related entity sets form the primay key of the resultant relation (explained next).

Mapping one-one Relationships

- One-exact one relationship: the key of the one-side entity set becomes the primary key of the mapped relation.

Best(key-of-Movie*, Studio*)

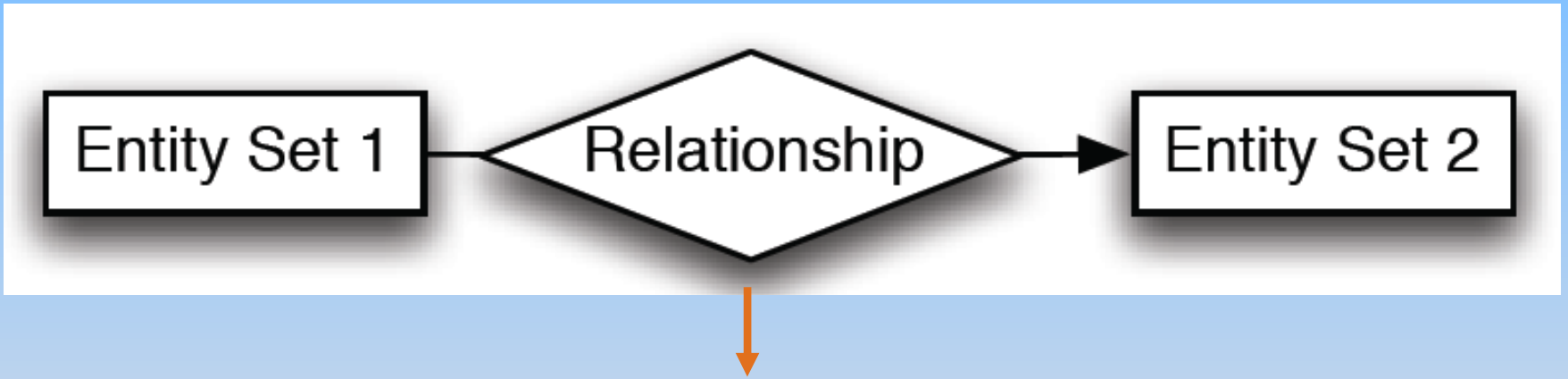
- One-one relationship: the key of entity set at either side becomes the primary key of the mapped relation.

R(key-of-entityset1*, key-of-entityset2*), or

R(key-of-entityset1*, key-of-entity-set2*)

Mapping many-one Relationships

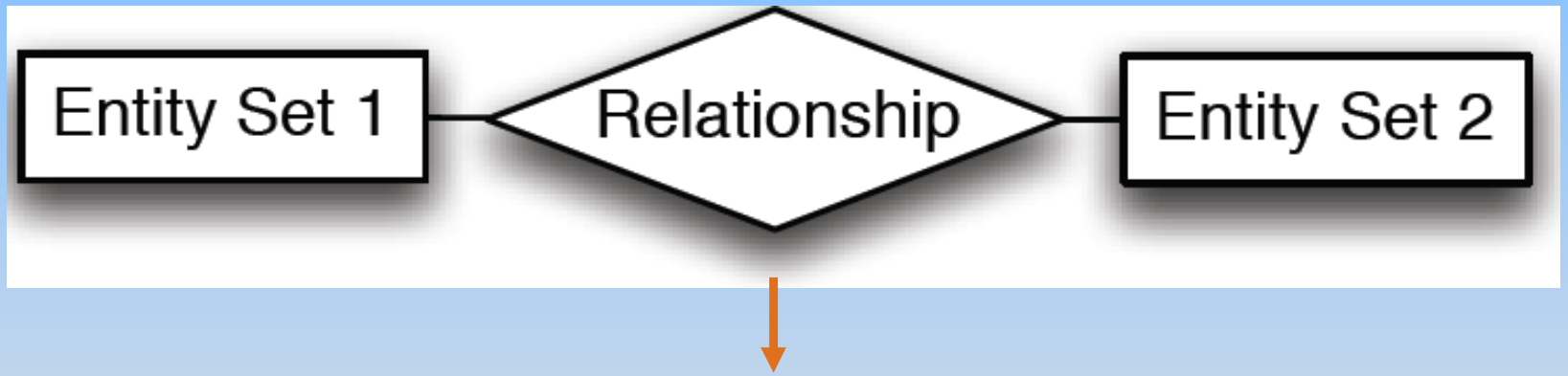
- Many-One relationship: key of the entity set at the "many" side becomes the primary key of the mapped relation.



R(<u>key-of-entity set1</u>*, key-of-entity set 2*)

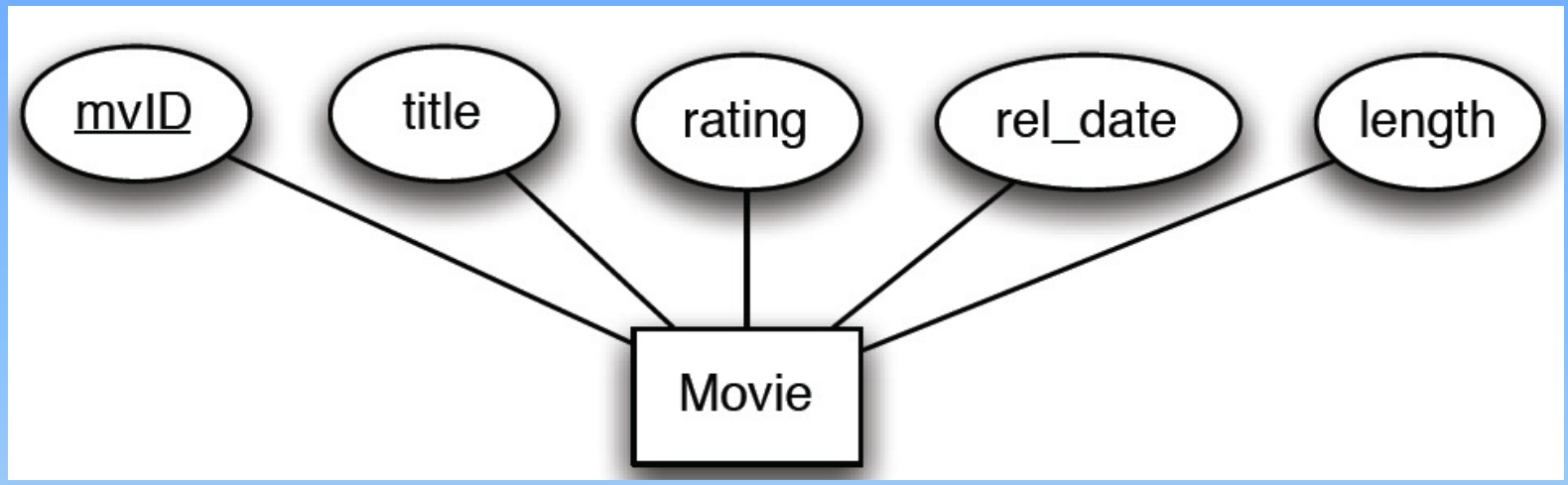
Mapping many-many Relationships

Many-Many relationship: the keys of entity sets at both sides together form the key of the mapped relation.



R(key-of-entity set 1*, key-of-entity set 2*)

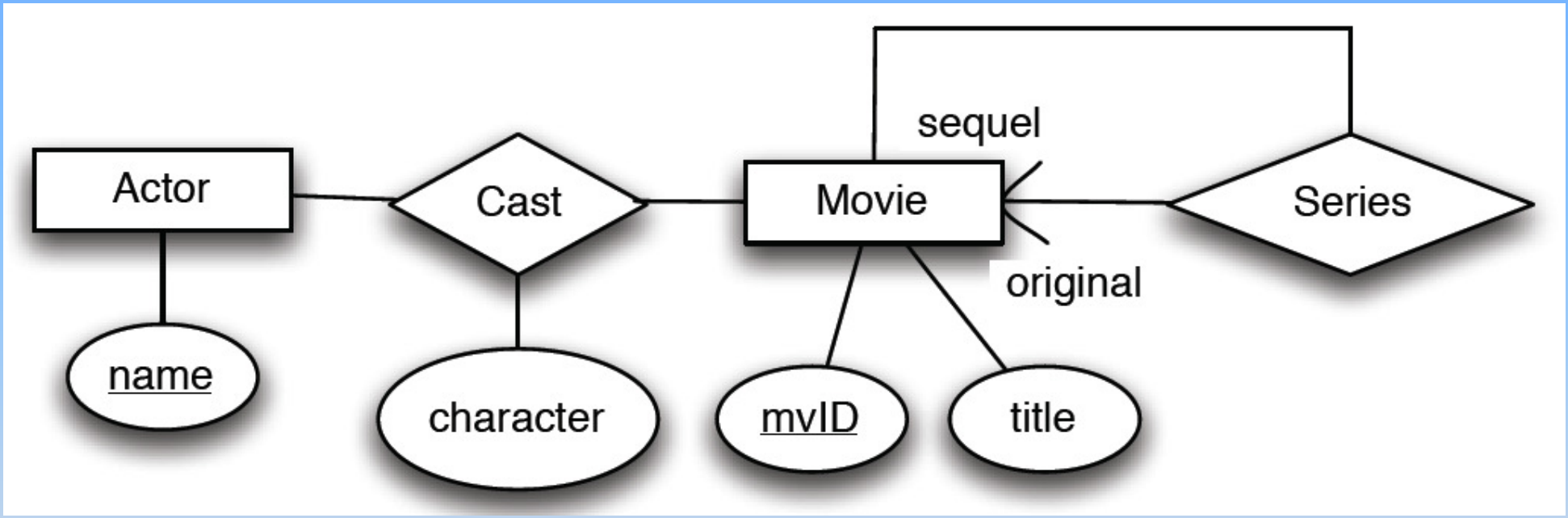
Example: Entity Set → Relation



Relation:

Movie(mvID, title, rating, rel_date, length)

Example: Relationship → Relation



For clarity, not all attributes of entities are shown in the E/R diagram.

Relationship → Relation

Actor (name)

Movie(mvID, title)

Cast(Actor-Name*, MvID*, character)

Series(sequel-mvID*, original-mvID*)

Notes:

- Entity sets and relationships in E/R diagrams have distinct names and are mapped to relations.
- Good practice for naming attributes:
  - Entity-Key: e.g., Actor-name.
  - Role-Key: e.g., original-mvID, sequel-mvID.

Exercise: Map the Village Cinema Database ER diagram into Relations